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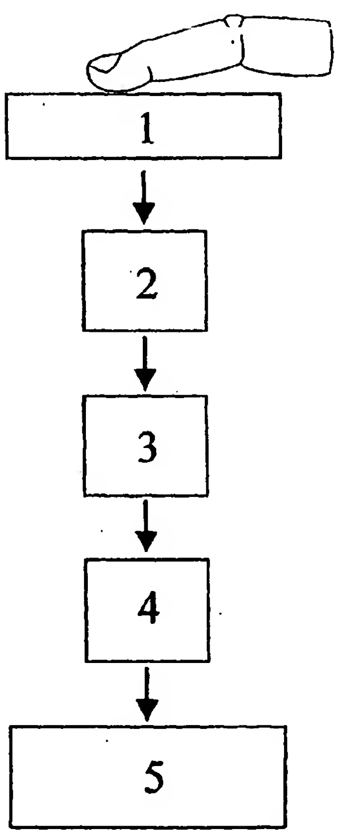
(54) Title: CHARACTER INPUT USING A FINGERPRINT SENSOR



(57) Abstract: The invention relates to a sign generator, as well as method and system comrpsing this, especially for cellular phones including at least one touch or pressure activated switch and a display, analysing means for measuring the connection periods and categorising the periods into at least two categories, storage means for storing sequences of the categorised periods, and translating means for translating said stored sequences into signs according to a predetermined table and indicating the signs on the display.

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Character input using a fingerprint sensor

This invention relates to use of a sign/character generator represented by a fingerprint sensor with navigation means, for text/sign input to communication devices with displays, such as cellular phones, palmtop PCs, PDAs, etc.

Recently there has been an enormous growth in the use of SMS (Short Message System) for text transmissions between cellular phones. The limited size of such phones does, however, represent constraints to the size of keyboards, causing generation of text/character input to the phone to be a slow and cumbersome process. Normally cellular phones have reduced keyboards with a limited number of keys, normally far less than the normal letters of the alphabet. The solution of present mobile phones is to let each number key represent 3 or 4 subsequent letters. Refer figure 1. For example the key usually giving number 6 will in the alphanumeric mode define one of the letters m, n or o, pending the number of times the key is pressed. Thus the word "hello" may be written by pressing key number 4 twice, key number 3 twice, key number 5 thrice, key number 5 thrice and key number 6 thrice, thus pressing the keys a total of 13 times. The user needs to memorise the positions of these alphanumeric keys, or look up their positions and shift finger position from key to key, as per the above example.

One manufacturer, Ericsson, provides an external QWERTY keyboard as a plug-in device to their cellular phones. This solution has, however, the disadvantages of extra size, weight and costs, being directly contrary to user requests for increasingly smaller, lighter, cheaper and more versatile cell phones.

Another known solution is the Nokia Naviroller™ in which a mechanical barrel on the front panel is rolled by the finger, bringing up a vertical column of signs and characters on the display. Selection of a particular sign or character is performed by mechanically pressing down the barrel. In practice this is not a faster solution than

moving the finger from key to key and pressing the selected key one or multiple times. The Naviroller™ solution also imposes a serious constrain on the cursor movements as it limits cursor movements to one dimension; <up> and <down>, except for pressing the barrel for character selection.

Tegic Communications has developed a system called T9™ whereby software logic search for legal letter combinations of a particular language, thereby minimising the multiple presses of any key representing multiple characters, as shown in figure 1. This is an elegant solution as the number of finger taps is presumably significantly reduced, but the negative aspect is that it requires a translation program for each language, and that these must be stored in the phone memory. Motorola is said to have developed a similar solution, called iTap™, thus having the same problems.

Sign handling of another known type is the Zi 8™ provided by ZiCorp, to facilitate character input by Chinese signs through a limited keyboard, as shown in figure 1. It is based on the fact that Chinese signs are composed of so called basic strokes, which sequence defines a particular sign. These basic strokes are assigned to the keys, much in a similar way as the letters are assigned to the number keys, as shown in figure 1. This solution enables input of Chinese characters by a regular cellular phone keyboard, as per figure 1, but does not resolve the main problem of using a keyboard for sign/character input to a communication device with display. A keyboard is still required, and due to size limitations it normally contains far less keys than the characters/signs required to compose a meaningful message. The finger therefore has to be moved around the keyboard, and each key may need to be pressed down mechanically multiple times to select a message.

US 6,057,540 describes an optical sensor with navigation utilities. It's dimensions and complexity, however, makes unsuitable for usse in mobile phones and similar. Also, as the sensor described here preferably uses a 16x16 pixel matrix it is not suitable for use as a fingerprint sensor, since the resolution is unsufficient.

US 5,608,395 describes a telegraph key connected to a

computer for writing text. The characters are organized in a hierarchy for demanding a minimum memory for choosing each character. This solution is also to complicated and large and does not have the advantage of using existing sensors in modile phones or similar.

The above illustrates the present situation for compact communication devices like cellular phones, where complex text input is cumbersome as such input has to be generated through the limited keyboard of figure 1. The next generation of cellular phones comprises so-called WAP phones with Internet access. In general this development calls for increased displays, for better readability of the far more extensive information available to the user. Preferably increased display size should not increase the cell phone size. The most viable way to increase display size without increasing the phone size will be to reduce the keyboard size, preferably to a single row of buttons, comprising e.g. three or less number of buttons, as shown in fig. 2, but still enabling complex text input to the cellular phone. None of the above solutions will function satisfactorily with such a minimum "keyboard".

The Morse alphabet is a known method for convenient and high-speed text input. It may be used for input to information/communication devices with comparative large displays and minimised "keyboards" as per fig. 2, provided one of the keys can be used for Morse sign input. The Morse code is a very fast and efficient method for standard characters, such as Latin letters or Arab numbers. However, it poses serious constrains when it comes to special characters/signs that may either be represented by very long and cumbersome sequences of dots and dashes, or which are not included in the standard Morse alphabet at all.

Thus it is an objective of this invention to provide a method for efficient text input to information/communication devices with minimum keyboards with at least one key, by a combination of Morse alphabet sign input and character selection from the display, by finger commands on a touch-sensitive switch. This solution will supplement the high input speed of the Morse alphabet with the flexibility of

selecting special characters/signs from a display. These objects are obtained using a sign generator characterized as described in the accompanying independent claims.

The invention will be described below by way of example and with reference to the accompanying drawings.

Fig. 1 illustrates a traditional reduced keyboard for cellular phones, with multi-character keys.

Fig. 2 illustrates schematically new cellular phones with large display and a single sign-generator key, as part of a minimum "keyboard".

Fig. 3 illustrates the invention schematically.

Fig. 4 illustrates categories of finger movements in two dimensions.

Fig. 5 illustrates schematically the Input Modes that the invention may work under.

Fig. 6 illustrates the use of a preferred embodiment of the invention to write a message by the Morse alphabet.

Fig. 7 illustrates typical finger command interfacing with the information/communication device.

First the principle of the invention will be described, followed by a description of simple Morse sign input. Finally will be described multiple mode input by combination of simple Morse signs with generating characters from selection screens on the display, all by finger commands.

The principle of the invention is illustrated schematically in fig. 3. A touch sensitive switch 1 is coupled to analysing means 2. The analysing means measures the connection time of the switch and categorises the signal from the switch into at least two categories, depending on the length of the connection time. The classified categories of data are stored in a memory 3 and are compared by a translation means 4 with a predefined table relating input signal sequences to readable characters/signs. The signs corresponding to the sequences are then shown in the display 5 in a known manner. The form in which the data are presented on the screen, and how text input is interacted by the user is controlled by the translation means 4.

In a preferred embodiment of the invention the categories are translated according to a table comprising

the Morse alphabet. Thus the connection categories are stored as long (dash) and short (dot) signals. According to one embodiment of the invention the disconnection periods are also measured in order to distinguish between periods between the signals, the periods between complete signs and periods between words.

The connection categories may be selected by measuring the connection period t_m and comparing them t_{moff} with predefined limits separating the dots of the Morse alphabet from the dashes. In addition there should preferably be lower and upper limits for being registered as a signal. Signals being shorter than the lowest limit defined as t_{reg} may be ignored to avoid errors caused by accidental touches of the switch 1 e.g. due to handling of the information/communication device. Connection periods longer than the predefined limits may also be ignored, or may be classified as a separate code, for example "End of message". Table 1 defines typical time limits, as follows.

Table 1

Time Ranges	Nom. Values	Meaning	Type
0,001s < t_{Reg}< 0,100s	t_{Reg} = 0,01s	Reg. limit	Basic/Non-adapt
1,5 t_{Reg}< t_{off}< 50,0 t_{Reg}	t_{off} = 0,25s	Sign Sep.	Adaptive
1,5 t_{Reg}< t_{Short}< 50,0 t_{Reg}	t_{Short} = 0,25s	Dot	Adaptive
1,5 t_{Short}< t_{Long}< 5,0 t_{Short}	t_{Long} = 0,50s	Dash	Adaptive
1,5 t_{Long}< t_{Extra}< 10,0 t_{Long}	t_{Extra} > 0,75s	Period	Adaptive

In addition long disconnects may be registered as periods between signs.

The time limits of Table 1 above may of course be chosen otherwise. A particular embodiment of the invention is to set the above ranges dynamically to adapt to the user's skills and his learning curve in using the invention. This may be done by registering the e.g. 50 last commands of each type, and calculating the arithmetic mean and standard deviation. The statistics may be based upon any written text or a predetermined learning sequence, and may be used to shift the category definitions according to the speed of the user, and thus also adapt as the user learns the system and increases his input speed.

The touch-sensitive switch 1 may in its simplest form

be a simple on and off touch sensitive switch. As explained above the Morse alphabet is a very fast method of generating standard Latin letters or Arab numbers, as the Morse alphabet is so constructed that the most frequently used characters are assigned with least numbers of Morse signs (dashes/dots). Accordingly special characters/signs may be represented by long and cumbersome sequences of dots and dashes, or may not be defined at all in the standard Morse alphabet. Accordingly the preferred embodiment of the invention is to combine the Morse input mode with other input modes, such as selection of characters from selection screens in the display by finger commands. In order to implement a comprehensive and intuitive set of finger commands in the interpretation/translation means 4 it is necessary to expand the finger commands from vertical taps of predefined duration categories (dots and dashes) with lateral finger commands. Accordingly the preferred embodiment of the invention the switch is also capable of registering lateral finger movements on the switch. A suitable sensor is described in EP 735.502, which describes a line shaped fingerprint sensor. The fingerprint sensor described in this patent publication scans the fingerprint, and in order to be able to analyse the finger-print, is able to detect the finger movement across the sensor. Thus such sensors are able to both detect the finger as it touches the sensor, and to detect a lateral finger movements. For example a finger movement across the sensor may be used to indicate separation between two letters, while another movement may be used to separate two words. Another incentive for this preferred embodiment of the invention by using a fingerprint sensor capable of also registering lateral movements (fingerprint sensor with navigation means) is that information/communication devices in most cases contain privileged and proprietary information which might be highly sensitive. It is therefore beneficial to protect access to the device by biometrics such as identity verification by fingerprints. Accordingly the combined use of a fingerprint sensor with navigation means for both text input and for identity verification in a single sensor will be

very cost-efficient. The benefit of such a combined solution will further minimise the size of the keyboard, to maximise the display size, as illustrated by fig. 2.

This preferred embodiment of the invention using a single sensor for text input generation (by Morse signs, or by selecting characters/signs from the display) by finger commands and for access control by fingerprint biometrics is therefore cost-efficient and enables larger display size. Fig. 4 illustrates the preferred embodiment of the invention in which the switch 1 is capable of measuring finger movements in two dimensions. This may for example be obtained by using two orthogonal sensors of the type shown in the EP publication mentioned above. The figure illustrates categories of lateral finger movements that are used to build finger commands, either by basic finger moves, or combinations thereof. Fig. 4 defines ten lateral finger movement categories (in addition to vertical taps); eight directions of movements and two circular movements (clockwise and counter-clockwise). These may also be combined with time measurements to calculate the velocity of a movement, thus providing a number of differing categories from one single finger movement.

Such a combined sensor enables the invention to use comprehensive finger commands (with time measurements) in both the vertical direction (taps) and the horizontal directions (lateral finger motions). It is a key issue of this invention that such comprehensive finger commands are capable of providing convenient and flexible text input in both Morse mode and all other input modes, such as character selection by finger commands directly from the display. Typical examples of input modes by the invention are illustrated in fig. 5. This requires a finger command structure that is applicable to all input modes. Moreover the finger command structure must be intuitive within each input mode, to avoid the need for memorising complex finger commands. Such a finger command structure is exemplified in Table 2 below.

Table 2

Finger Command Structure

Display Mode Commands			
Vertical Screen Input Commands (One-character wide vertical Selection Fields)		**Horizontal Screen Input Commands** (One-line high Command Fields or Option Fields)	
Select Character	<Double Tap>	Select Command/option	<Double Tap>
One position down	<Finger Down>	One line down	<Finger Down>
Scroll down	<Finger Down – Hold>	Scroll down	<Finger Down – Hold>
One position up	<Finger Up>	One line up	<Finger Up>
Scroll up	<Finger Up – Hold>	Scroll up	<Finger Up – Hold>

Screen Manipulation Commands			
Toggle to horizontal fields	<Slanted Down Left>	Shift vertical fields	<Finger Right/Left>
Toggle to vertical fields	<Slanted Up Right>	Shift horizontal fields	<Finger Up/Down>
Toggle to/from Edit Text Mode		<Extra Long Tap> – <Finger Down>	

Edit Text Commands			
Home of Text Field	<Slanted Up Left>	Toggle to/from Edit Mode	*See Screen Manip. Commands*
End of Text Field	<Slanted Down Right>	Mark *n* characters left	<Long Tap> + *n* <Short Taps>
Move one position left	<Finger Left>	Mark *n* words left	<Long Tap> + *n* <Finger Left>
Scroll left	<Finger Left – Hold>	Shift marked letters' case	<Long Tap>
Move one position right	<Finger Right>	Delete marked character(s)	<Extra Long Tap>
Scroll right	<Finger Right – Hold>	Copy marked character(s)	<Double Tap>
One line up	<Finger Up>	Paste marked character(s)	Two <Double Taps>

Scroll up	<Finger Up - Hold>	Insert space right of cursor	<Short Tap>
One line down	<Finger Down>	Write to right of cursor	*Exit Edit to Input Mode*
Scroll down	<Finger Down - Hold>		

Morse Mode Commands		**Global Commands**		**Sign Language Commands**
Dot	<Short Tap>	Shift Input Mode	<Circ. Finger Move>	<Circular Finger Move> brings up Command Field w/ Sign Language Mode. <Double Tap> to select. Then use <Finger Down/Up> for Chinese, Japanese or Korean signs
Dash	<Long Tap>	Toggle Edit Text	*See Screen Commands*	
Sign sep.	<Finger Off; Short>	End of Text Input	Two <Extra Long Tap>	
Char. sep.	<Finger Off; Long>			
Word sep.	<Finger Down>			

The Finger Command Structure is a vital part of the translation means 4 of this invention. The analysing means 2 will register any Input Mode shift command (e.g. <Circular Finger Moves> according to Table 2) and thereby switch between the applicable finger sequence/movement categories applicable to each particular Input Mode. The translation means 4 will thereby interpret the resulting finger movement categories and sequences according to Table 1 and Table 2, and display the resulting sign/character on the display 5.

The invention thus uses a fingerprint sensor with navigation means 1, as touch-sensitive switch with multiple

input modes possible in addition to simple Morse sign input.

The preferred embodiment of the invention is exemplified in fig. 2. The information/communication device (cellular phone, palmtop PC, PDA, etc.) comprises a display 5 which size is maximised relative to the overall dimensions of the device. In addition to the display 5 the device contains at least a touch-sensitive switch 1 and e.g. two function keys (6 and 7) that comprises a minimal "keyboard". The same touch-sensitive sensor is also a fingerprint sensor enabling access control to the device by identity verification through fingerprint biometrics.

A typical input example by use of the invention is illustrated in fig. 6. Fig. 6a shows the example text string; "This is a text example." comprising 23 characters including spaces between the words. Fig. 6b shows the text input by Morse finger commands on the switch, using short taps for dots and long taps for dashes of the Morse alphabet according to sequences as per Table 1. Fig. 6b also shows that separation between words is performed by the finger command <Finger Down>. Fig. 6b shows totally 43 finger moves (short and long taps, and words separated by <Finger Down>) to input the text example. However, these finger moves can be very swiftly executed as it only involves vertical movements of the finger, at the same location. Fig. 6d shows the same input by using a reduced keyboard as per fig. 1 with multiple letter representations on each key. The numbers in fig. 6d refer to the key numbers, while the quantity of each number shows how many times each key has to be pressed to select the letter. The arrows at the base of fig. 6d indicate lateral shift of finger positions between the respective keys. From fig. 6d it can be seen that regular input by tapping keys on a reduced keyboard with multiple letter representations requires 41 key taps supplemented by 21 lateral finger position shifts, totalling 62 finger movements, which is about 50 % more finger moves than the same input by the Morse alphabet.

Even more important is it that the invention allows significantly increased display size (for WAP applications) as per fig. 2, as the large keyboard of fig. 1 is replaced by a single sign-generator button supplemented by e.g. two function

keys.

Fig. 7 illustrates the multiple-mode input versatility of the invention that enables such single-key versatility. Fig. 7a shows the display 5 of the device, and underneath the touch-sensitive sensor 1 with navigation means, plus two function keys (6 and 7). The display comprises a vertical selection field 8 and a horizontal command field 9. Both are controlled by finger commands on the switch 1. Switching between the vertical selection field and the horizontal command field is done by intuitive finger commands 10, in this case <Slanted Finger Down Left> and <Slanted Finger Up Right> respectively, as illustrated in fig. 7a. Fig. 7b illustrates sets of vertical selection fields 15; typically special characters. Arab numbers, capital letters, minor letters, rare letters, Greek letters, etc. Character selection within a vertical selection field is performed by <Finger Down> or <Finger Up> commands (refer Table 2 for scroll commands) until the requested character is in marked position, and then <Double Tap> for selection and entry of the character into the text on the display 5. Switching between the applicable vertical selection fields 15 is done by commands 14 <Finger Left> or <Finger Right> as per fig. 7b. At the base of fig. 7a is displayed how input mode may be shifted, while typical input modes are exemplified in fig. 7c. The default mode can be Alphanumeric Input (Latin alphabet) by the Display Mode, as per fig. 5. The following example illustrates how the user may shift from this default mode to Chinese sign-based language, with reference to figs. 7a and 7c. First he makes a <Circular Finger Move> 11 on the sensor 1. This pops up the horizontal command field of fig. 7a, displaying the default input mode. The user continues with discrete <Circular Finger Moves> flipping through the alternative input modes as per fig. 7c until e.g. the requested alternative Sign-Based Languages is displayed in the horizontal Command Field 9. He then enters the finger command 12 <Double Tap> on the sensor 1 to confirm his selection of Sign-Based Languages. He then makes another finger command 13 <Finger Down> or <Finger Up> to flip through the alternative sign-based languages, which may comprise Chinese, Japanese and Korean, as per fig. 7a. The user may now

select the signs of the text directly from the vertical selection field (where they could be arranged in selection field sets arranged e.g. by first strokes). A preferable embodiment of the invention is that he selects the Draw Mode (fig. 5) drawing either Zi 8™ reduced strokes, or basic strokes, or the entire sign directly on the sensor 1. Other alternative input languages per fig. 7c are e.g. Character-based Languages (comprising Latin alphabet, Greek alphabet, Arab or Cyrillic) or Mathematics comprising e.g. arithmetic, trigonometry of differential operations.

In accordance with the above description the invention comprises the following elements, with reference to fig. 3;

A single input button in the form of a touch-sensitive switch 1 comprising a fingerprint sensor as e.g. described in EP 735.502, with ability to register connection (and their duration) (time) of finger on sensor. The sensor will also register lateral finger movements including direction and finger speed, through a sensor pattern with associated movement categories as shown in fig. 4.

Analysing means 2 which by "global" finger commands (as per Tables 1 and 2) will be set in different input modes, each mode being associated with a particular set of finger movement categories and sequences which the output signals from the sensor 1 will be analysed versus and compared to.

Storage means 3 which serves as a buffer while the translation means 4 compare the identified categories and sequences of finger commands with the Finger Command Structure, typically as per Table 2.

The translation means 4 also comprises interfacing to the processor of the information/communication device, to print out the inputted signs/characters on the display 5.

The preferred embodiment of the invention as described above gives the following three major advantages compared to other known solutions;

- The touch-sensitive switch 1 with navigation means 1 allows for very fast text input by the Morse alphabet by a single key, in combination with the predefined sets of categories and sequences as per Table 1.
- The combination of the switch 1 used as Morse key, with

the Finger Command Structure (Table 2) implemented in the translation means 4, provides additional versatility and flexibility. This is because the very fast Morse mode can be used for standard text input (Latin letters and Arab numbers) while special characters and signs can be conveniently generated by switching back and fro to the other input modes, such as e.g. Display Input Mode.

- The touch-sensitive switch 1 with navigation means provides the combination of a touch-pad, a fingerprint sensor and a text input generator, all in a single combined button. This is highly cost efficient, and above all enables reduction of the required keyboard (as per fig. 2) compared with the traditional solution shown in fig. 1. This combination can not be achieved by the single-directional NaviRoller™.

Claims

1. Use of a fingerprint sensor in a cellular phone or similar as a touch or pressure activated switch for writing signs, the cellular phone further comprising:

a display for displaying information,

analysing means for measuring the aktivation periods and categorising the periods into at least two categories,

storage means for storing sequences of the categorised periods, and

translating means for translating said stored sequences into signs according to a predetermined table and indicating the signs on the display.

2. Use according to claim 1, wherein the lengths of the disconnection periods are also measured.

3. Use according to claim 1, wherein the set of categories comprises the Morse alphabet.

4. Use according to claim 1, wherein the fingerprint sensor is a linear fingerprint sensor being sensitive to movements in at least one direction.

5. Use according to claim 2, wherein the sensor being capable of measuring movements in two dimensions, said analysing means also being capable of categorising said two dimensional movements according to a chosen set of categories including the directions and duration of said movements, and said predetermined table in said translating means including said set of categories corresponding to chosen signs.

6. Use according to claim 5, wherein the set of categories comprises linear movements in at least eight directions and two circular movements, clockwise and counter-clockwise.

7. Use according to claim 5, wherein the categories are organised in a hierarchy, the first finger movement thus selecting a first set of signs, the second movement selecting a sign or subgroup from the first set of signs.

8. Use according to claim 7, wherein the hierarchy has at least three levels.

9. Use according to claim 7, wherein the categories define a Chinese sign set.

10. Method for using a using a fingerprint sensor according to claim 4 or 5 in which measuring finger movements across the sensor in at least one dimension,

using the analysing means for categorising finger movements across the sign generator according to predefined sets of finger movement sequences including directional and touch/no-touch finger movement sequences,

using the translating means including uniquely defined command table for translating the categorised finger movements into signals controlling the display as results of the finger movements on the sensor.

11. Method according to claim 10, wherein the categories are ordered in a hierarchy, a first categorised finger movement thus selecting a first set of signs, the second categorised movement selecting a sign or subgroup from the first set of signs.

12. Method according to claim 13, wherein the hierarchy has at least three levels.

13. Method according to claim 11, wherein the categories define a Chinese sign set.

14. Method according to claim 10, wherein the finger movements control cursor movements on the display within the selected table of characters, signs or commands.

15. Method according to claim 14, wherein at least one finger movement controls the selection of the desired character, sign or command which the cursor has been moved to within the selected table.

16. Method according to claim 10, wherein at least two of the categorised movements is related to a control signal for the display, said display indicating a list of signs and said control signal indicating scrolling and choosing in said list or lists.

17. Sign generator system for information/communication devices, comprising a combination of a touch-sensitive fingerprint sensor with navigation means coupled with an analysing means containing sequenced categories of finger commands and coupled to a translation means based on a Finger Command Structure, providing full versatility in text input through a single-key input device.

Fig. 3

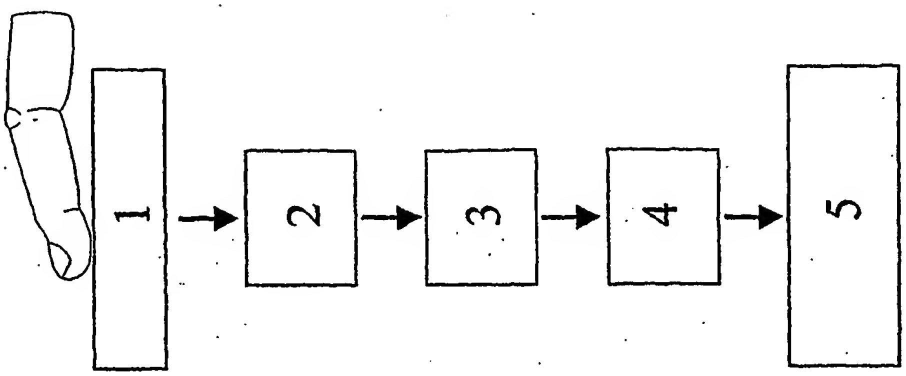


Fig. 2

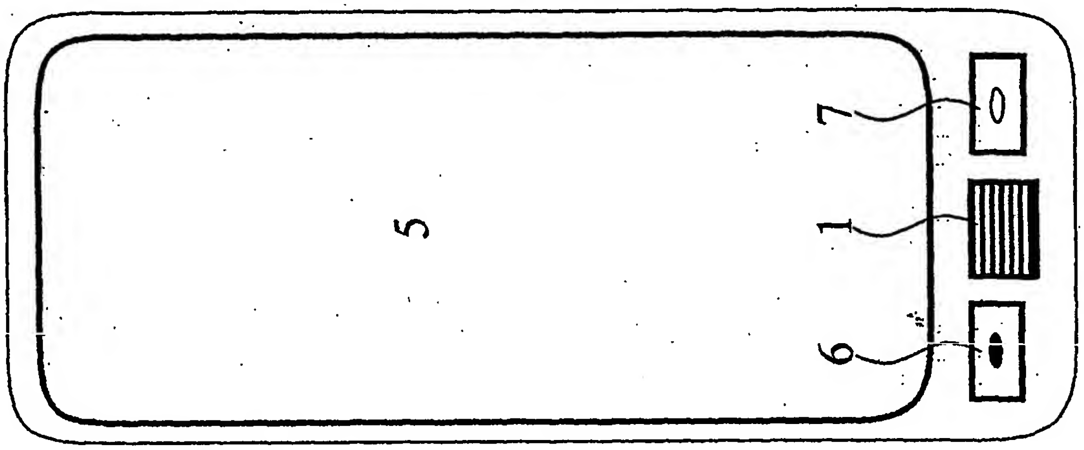
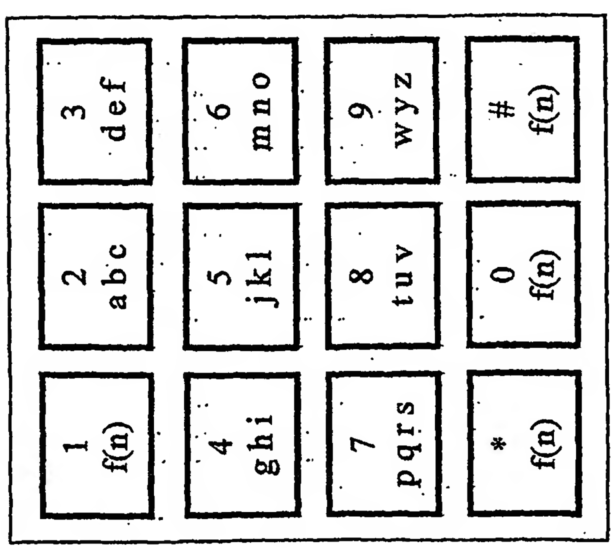


Fig. 1



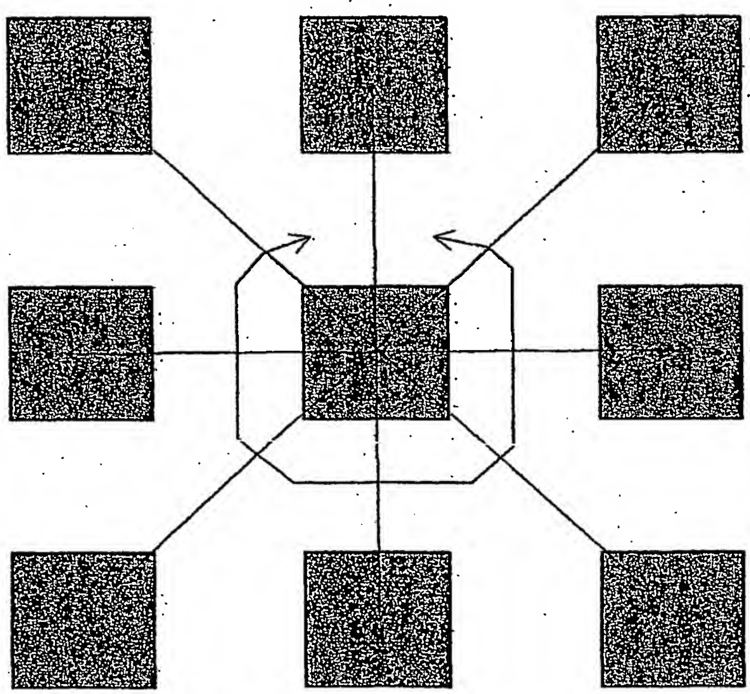


Fig. 4

Fig. 5

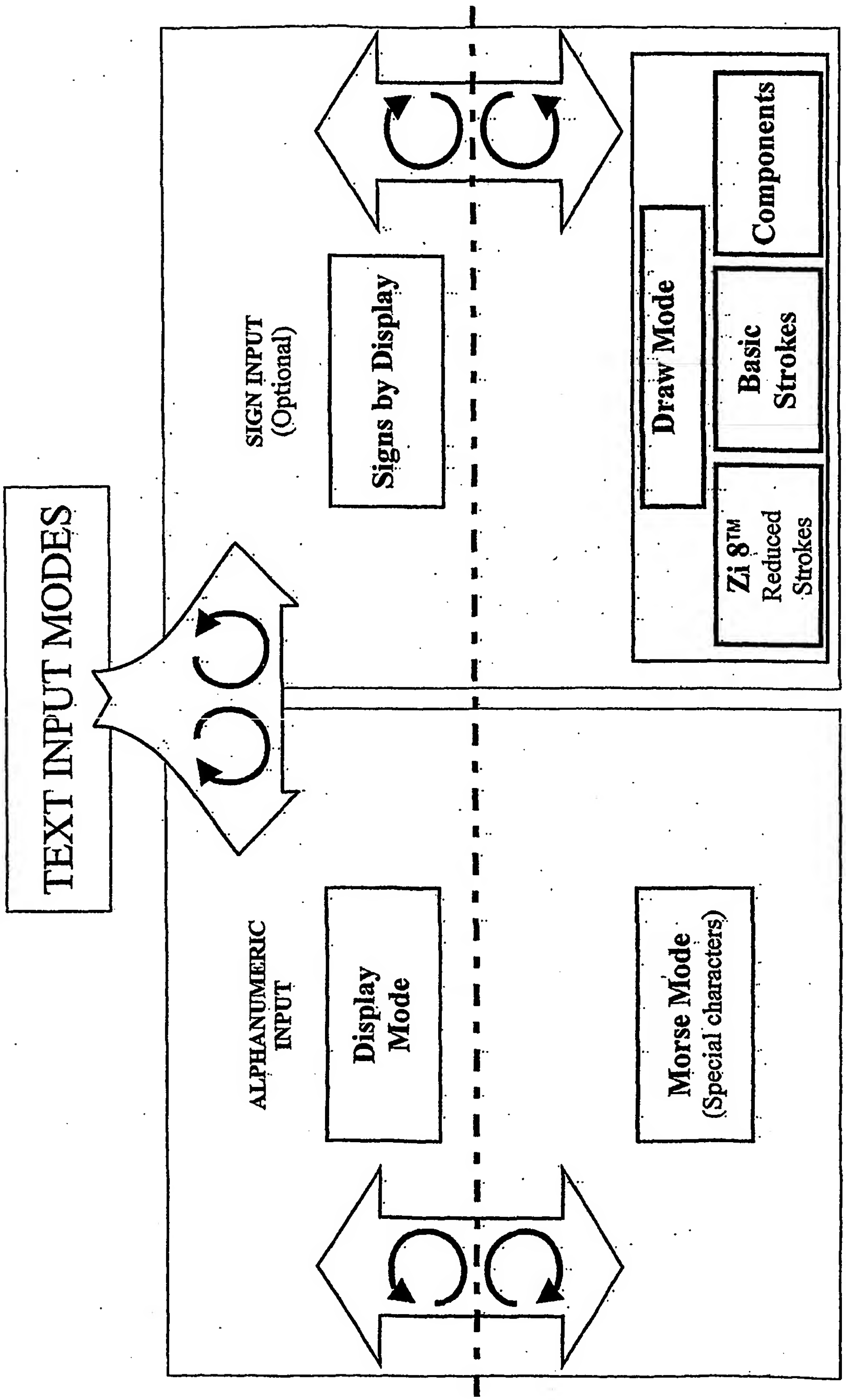

TEXT INPUT MODES
SIGN INPUT
(Optional)
Signs by Display
Draw Mode
Zi 8™
Reduced
Strokes
Basic
Strokes
Components
ALPHANUMERIC
INPUT
Display
Mode
Morse Mode
(Special characters)

Fig. 6

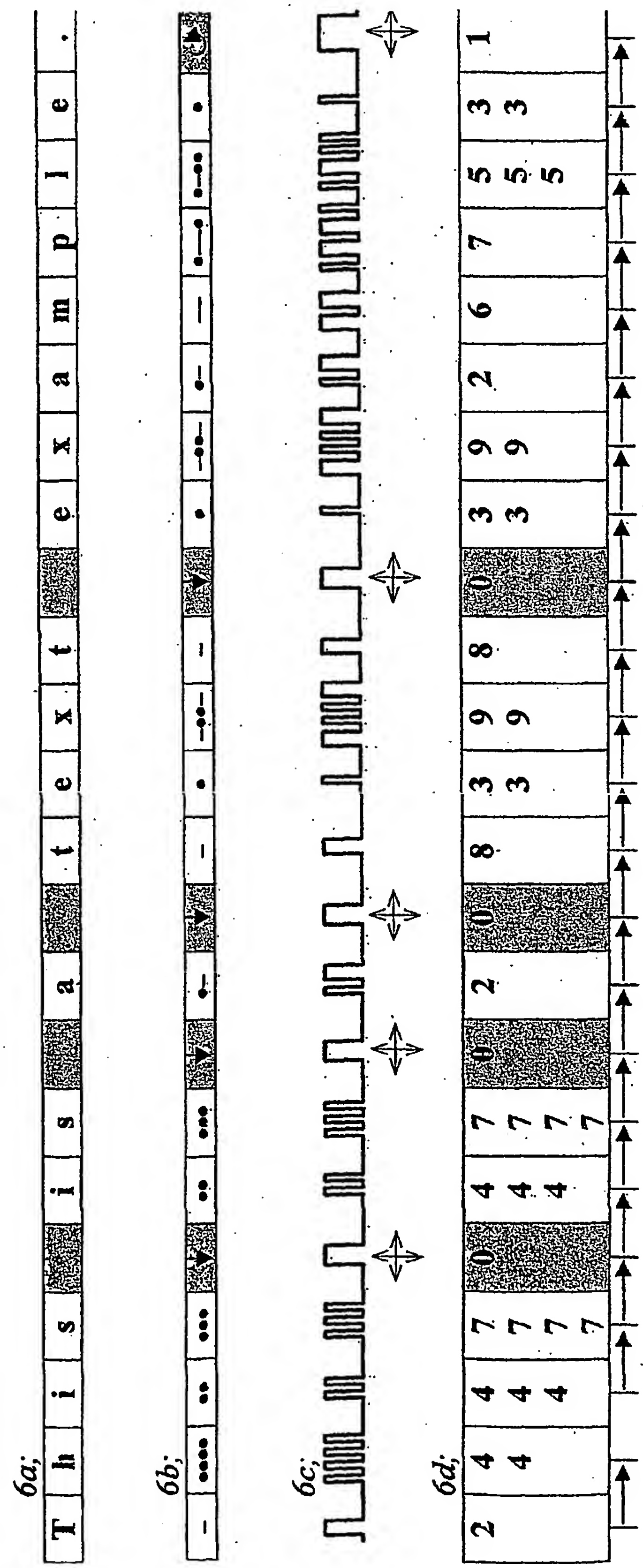


Fig. 7

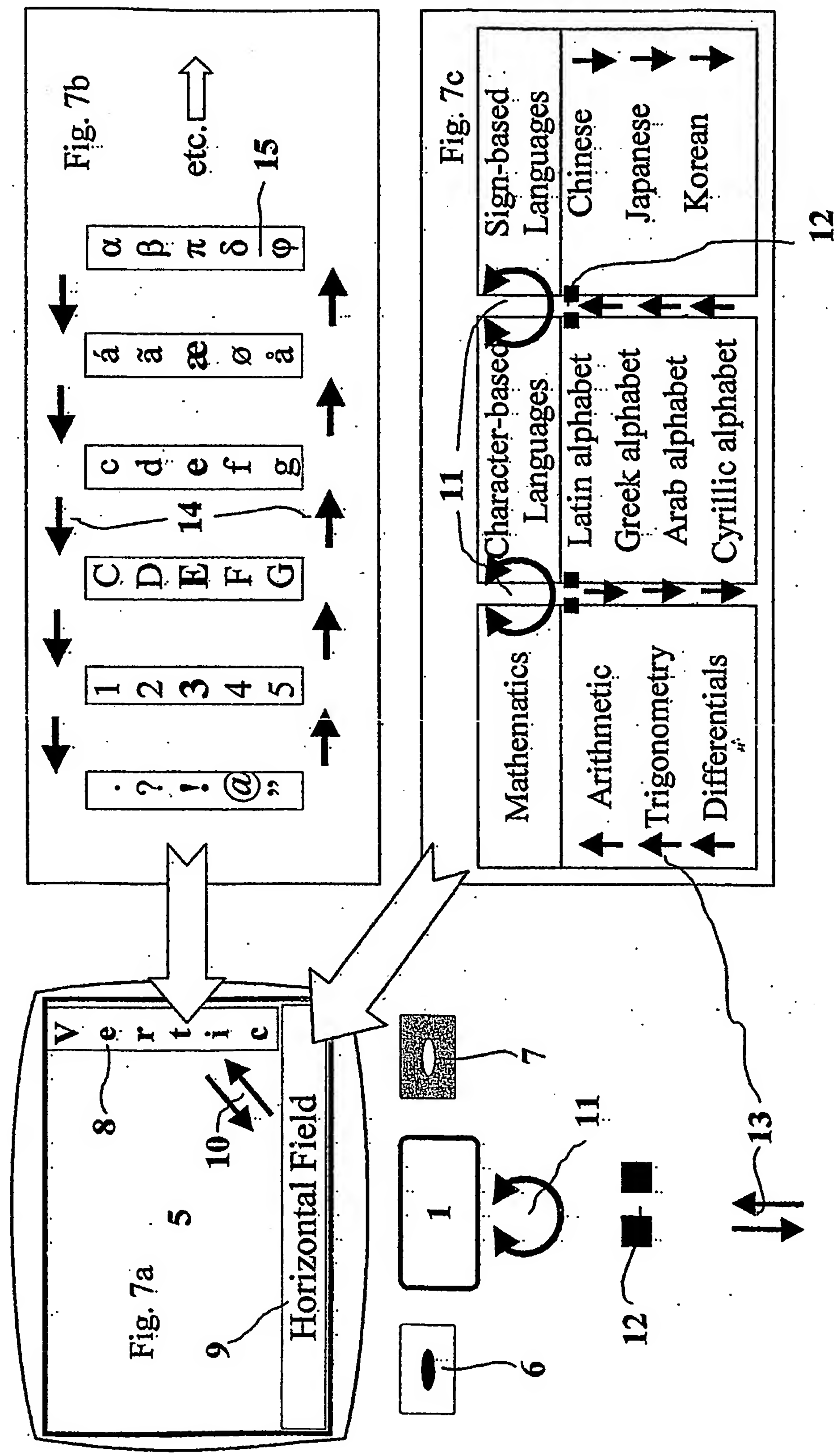


Fig. 7a
Fig. 7b
Fig. 7c
V
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Horizontal Field
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Sign-based Languages
Chinese
Japanese
Korean

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 01/00383

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G06F 3/00, H04M 1/247
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G06F, G06K, H04B, H04M, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5608395 A (KURTZ ET AL), 4 March 1997 (04.03.97), column 2, line 9 - column 7, line 12, figures 1-2, abstract --	1-17
Y	US 6057540 A (GORDON ET AL), 2 May 2000 (02.05.00), column 2, line 57 - column 9, line 67, figures 1-2, abstract --	1-17
Y	EP 0973123 A1 (LUCENT TECHNOLOGIES INC.), 19 January 2000 (19.01.00), column 1, line 25 - column 5, line 50, figures 1-3, abstract --	1-17

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 January 2002	04-02-2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Roland Landström/js Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 01/00383

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0929028 A2 (STMICROELECTRONICS, INC.), 14 July 1999 (14.07.99), column 2, line 16 - column 7, line 39, figures 1-6, abstract --	1-17
Y	EP 0969644 A1 (NOKIA MOBILE PHONES LTD.), 5 January 2000 (05.01.00), column 1, line 36 - column 8, line 12, figures 1-5, abstract --	1-17
Y	EP 0924948 A1 (SIEMENS AKTIENGESELLSCHAFT), 23 June 1999 (23.06.99), column 1, line 46 - column 2, line 42, figure 1, abstract --	1-17
Y	DE 19528734 A1 (SIEMENS AG), 6 February 1979 (06.02.79), column 1, line 1 - column 2, line 10, figures 1-7, abstract --	1-17
Y	EP 0927949 A2 (SAMSUNG ELECTRONICS CO. LTD.), 7 July 1999 (07.07.99), column 1, line 53 - column 10, line 53, figures 1-5b --	1-17
Y	US 4758979 A (CHIAO-YUEH), 19 July 1988 (19.07.88), column 1, line 35 - column 10, line 50, figures 1-4, abstract --	1-17
Y	US 5977948 A (NISHIBORI), 2 November 1999 (02.11.99), column 2, line 5 - column 9, line 34, figures 1-22 -- ---------	1-17

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/NO 01/00383

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